2008 Oceanography B National Outline

Information for students, coaches, and tournament coordinators

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The following outline gives some useful questions and links. While it is not exhaustive, I'd suggest that tournament coordinators who plan to add other topics to make it clear to students (as an example, I found that at one of the tournaments last year a lot of questions about scuba diving were asked-something that appeared in only one textbook). The topics here are either fairly standard across a range of textbooks, or can be found on the web.

I. Seawater and its constituents
- A. What are the consequences of seawater being a polar molecule?
- B. Why is the sea salty (where does the salt come from)?
- C. What is the relationship between salinity and chlorinity?
- D. What determines the pH of seawater?
- E. What are the major nutrients in seawater?
- F. How does the density of seawater vary with respect to temperature?
- G. How does the density of seawater vary with respect to salinity?
- H. How does the density of seawater vary with respect to pressure?
- I. What is potential temperature and why is it a useful concept?
- J. What is potential density and why is it a useful concept?

II. Variations of hydrographic properties
- A. How do temperature and salinity vary in the ocean basins?
- B. What are the sources of this variation?
- C. What can we learn from looking at a plot of temperature vs. salinity?
- D. What processes control the distribution of nutrients and oxygen in the ocean?
- E. What can we learn about ocean circulation from the distribution of nutrients?
- F. What processes control the distribution of radiocarbon in the ocean?
- G. How can radiocarbon be used to learn about ocean circulation?
- H. How are hydrographic properties used to define water masses?
- I. What are the properties of the following water masses: North Atlantic Deep Water, Antarctic Bottom Waters, North Pacific Deep Waters, Mediterranean Sea Water, Indian Ocean Deep Waters, Central Waters, Antarctic Intermediate Water, Subantarctic Mode Waters, Oxygen minimum zones
- J. What are the characteristic properties of the mixed layer?
- K. What are the characteristic properties of the thermocline/pycnocline?
- L. What are the characteristic properties of the abyssal ocean?

III. How are the following measured?
- A. Hydrographic properties (temperature, salinity, oxygen, nutrients)
- B. Dynamic properties (current, sea surface height, waves)
- C. Physical properties (depth, topography, sediment composition)
- D. How are satellites used to measure temperature and estimate currents?
- E. What is the ARGO program and how is it changing oceanography?

IV. Physics of the mean ocean circulation

A. What is the Coriolis and how does it work?
B. What is Ekman balance and how does it work?
C. What is Sverdrup balance and how does it work?
D. Why are the return flows for gyres found on the west?
E. How do the winds drive upwelling zones?
F. Why is the water along the equator colder than the water to the north and south?
G. Where are the following currents located: Gulf Stream, North Atlantic Current, Labrador, Canary, Azores, East and West Greenland, Norwegian Coastal, North Brazil, Brazil, Falklands/Malvinas, Antarctic Circumpolar, Flinders, Agulhas, Benguela, Somali, Equatorial Undercurrent, North Equatorial Countercurrent
H. How do waves cause longshore currents?
I. How do waves cause rip currents?

V. Physics of waves
A. How does a surface gravity wave work?
B. What's the difference between deep water and shallow water waves?
C. What determines the speed of a shallow water wave?
D. Is a tsunami a deep or shallow water wave?
E. What are the forces that cause tides?
F. Why do different locations have different numbers of high tides each day?
G. Why does the tidal amplitude change over time?

VI. Coupled Ocean/atmosphere processes
A. What drives land/sea breezes?
B. What drives monsoon circulations?
C. What is El Nino and how does it work?
E. What is the role of Kelvin and Rossby waves in driving El Nino?
F. How can we predict El Nino using ocean observations?
G. What are the impacts of El Nino and La Nina on North America?
H. How are hurricanes affected by the distribution of heat in the ocean?

VII. Geological structure
A. How does the geography of an active continental margin differ from a passive continental margin?
B. How does the geology (composition of sediments) differ between the two?
C. How are atolls formed?
D. How are guyots formed?
E. How are island chains formed?
F. How are island arcs formed?
G. What is the mid-ocean ridge geological province?
H. What sorts of features are found near the mid-ocean ridge and how do they form?
I. How do coral reefs form?
J. What are hydrothermal vents?
K. What are cold seeps?

VIII. Sediments and coastlines

A. What kinds of material are found in lithogenic, biogenic, hydrogenic and cosmogenic sediments?
B. How do beaches evolve over the course of a year?
C. How do sandbars form and move?
D. How do barrier islands form and move?
E. How do manmade structures affect beaches?
F. What are turbidity currents and what are their signatures on the ocean bottom?
G. What are sea stacks?
H. How do sea cliffs form?

Some resources for doing this event

The answers to many of these questions can be found in standard textbooks. Good ones include

Garrison, Oceanography- An invitation to marine science
Thurman, Essentials of oceanography, Introduction to oceanography
Duxbury, Duxbury and Sverdrup: Fundamentals of oceanography

Often these are re-released under slightly different titles. All three of the books above are available essentially new for under $20. Check out www.abebooks.com

A good free, online resource can be found at

http://www.uwsp.edu/geo/faculty/ritter/geog101/textbook/coastal_systems/outline.html

This is particularly useful for looking at coastal geology questions.

A good site for questions about El Nino is

http://www.pmel.noaa.gov/tao/elnino/nino-home.html

Clicking on the basic questions on this site will give you a lot of useful information. Additionally, the following web site

http://www.pmel.noaa.gov/tao/disdel/disdel.html

will enable you to make plots from actual data.

Two other sites where you can make plots are

http://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NODC/.WOA05/.Grid-1x1/.Annual/.an/figviewer.html?plottype=colors

This enables you to make plots from the World Ocean Atlas dataset. This will enable you to familiarize yourself with the distribution of a number of important, commonly measured tracers (temperature, salinity, apparent oxygen utilization, silicate…)

Once you've learned to use this Live Access Server to make plots, you can also check out the server at

http://cdiac3.ornl.gov/las/servlets/dataset?catitem=97

This site allows you to look at the distribution of some less standard tracers (alkalinity, radiocarbon) and then make maps of them. (Note: You will have to allow popups for this site to work).

NOAA's Coastal Services Center has a site on beach nourishment which has a lot of useful information on coastal geology and the evolution of beaches.

http://www.csc.noaa.gov/beachnourishment/html/geo/index.htm

Finally, I will be creating a website at

http://www.gfdl.noaa.gov/~a1g/science_olympiad.html

(Note: for reasons which would take far too long to explain, that's a-one-g)

At which I will be posting answers to some of these questions, suggested activities and links to other resources.

Some hints for doing well.

The rules for this event say that you can only make up a single sheet of resources. So that's all you need to prepare right? *Wrong*. The best preparation for this event, as with any event, is to build a binder in which you answer the questions above in detail. Answering them doesn't mean just copying a web page. It means coming up with your own answer and writing it down. Building a binder is how you will learn to answer these questions. Make your resource as an aid to memory from the binder.